
Why social psychologists using Structural Equation Modelling need to pre-register their studies

— Matt Williams, Massey University —

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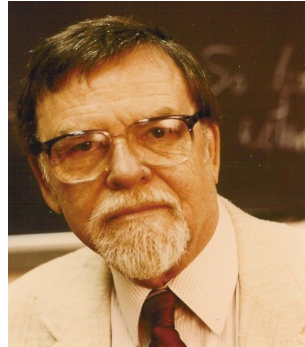
 @matthewmatix

The replication crisis in social psychology

- Replications of 100 psychological studies found that only about a third replicated the original result (Open Science Collaboration, 2015)
- Recent example: O'Donnell et al. (2018); replication of Dijksterhuis and van Knippenberg (1998, experiment 4)
 - Participants primed with either professor or soccer hooligan before completing a general knowledge test
 - Original study: statistically significant difference in scores of 13.1%
 - Replication (23 studies, $N = 4,493$): 0.14% difference, 95% CI $[-0.71\%, 1.00\%]$



Left: Football hooligans in France (Darren Fletcher / The Sun); Professor Paul Meehl (<http://meehl.umn.edu/>)



p-hacking

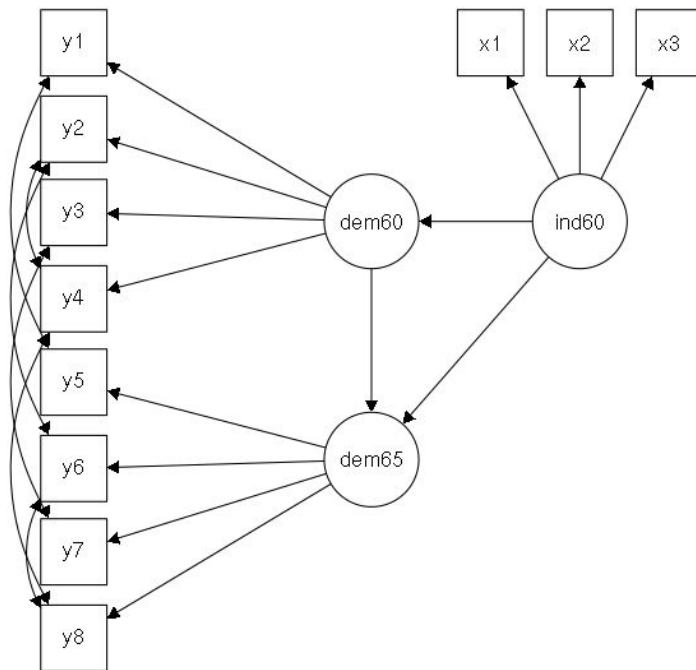
- One probable cause of problems with replicability: “undisclosed flexibility in data collection and analysis” (Simmons et al., 2011, p. 1359)
- Includes practices such as ‘hypothesising after the results are known’, reporting only those DVs that ‘worked’, running moderator analyses if main effects not present, stopping data collection only once $p < .05$, rounding down p values, etc.
- Such practices very common in psychology (see John et al., 2012)
- **Consequence: Bias in reported effect sizes & inflated Type 1 error rates**

Pre-registration

- Partial solution to replication crisis
- Entails committing to a plan for data collection and analysis **before** collecting data for a confirmatory study
 - Pre-registration recorded on a public archive (e.g., osf.io)
 - Restricting capacity for “undisclosed flexibility”
- Growing in popularity in experimental social psychology
 - E.g., recent special issue on pre-registered research in the Journal of Experimental Social Psychology (2016, vol. 67)

Structural equation modelling (SEM)

- Broad suite of statistical methods for testing relationships amongst observed and latent variables
 - Path analysis, confirmatory factor analysis, latent growth modelling, etc.
- Widely used in social psychology
- Allows specification of highly complex models.
- Pre-registration **rare** amongst psychological researchers using SEM



SEM - vulnerability to “undisclosed flexibility”?

- SEM requires *especially* many decisions in analytic process - paths, estimation method, error covariances, parcelling, disturbances, factor covariances, etc.
- Emphasis on global fit testing in SEM but:
 - **many** fit statistics available (χ^2 , RMSEA, CFI, TLI, SRMR, etc.)
 - variety of recommended thresholds for “good” fit available (see Hu and Bentler, 1999)
 - no consensus on how best to test.
 - see Personality and Individual Differences 42(5) special issue

Fit-hacking?

Therefore possible to:

- Apply *post hoc* tweaks to a model to display “good” fit to data at hand and/or
- selectively report fit statistics in such a way that a model appears to have good fit

And there seem to exist *incentives* for doing so

- Good-fitting models more likely to be published(?)

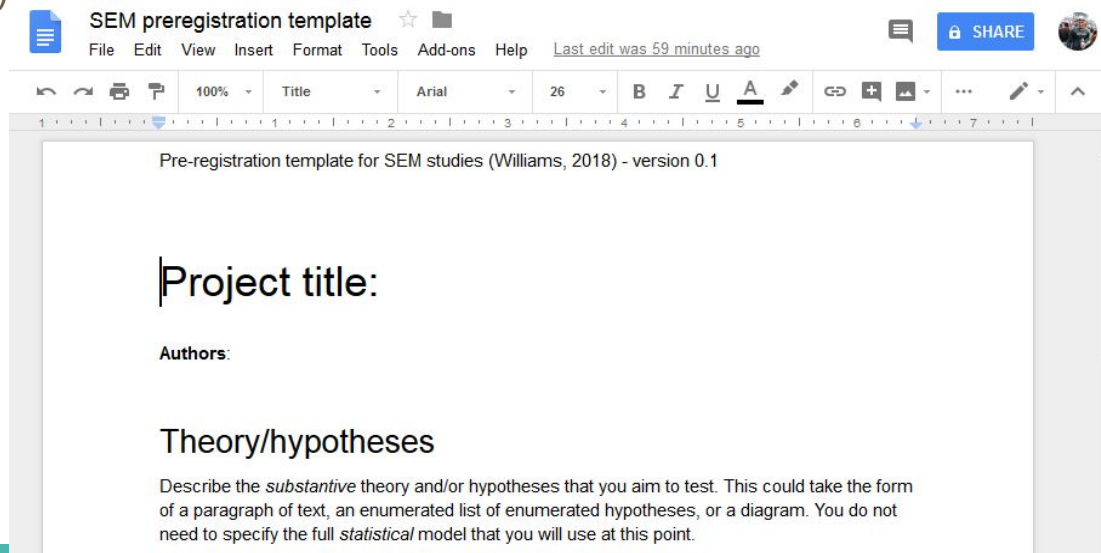
Probable outcomes: Published studies that provide an overly optimistic picture of the fit of models; high risk of unreplicable findings. (But more research on this needed!

Pre-registration in SEM

- Pre-registration therefore a crucial strategy in confirmatory SEM research
 - Ensures analyses planned in detail *before* data collection
 - Avoids possibility of using undisclosed flexibility to produce “positive” results
- Added benefit of pre-registration: Reduces stakes of the endless fit-statistics debate
 - If we commit to which fit statistics we will report ahead of time (and how we will interpret them), **then model is still falsifiable**
 - Regardless of which specific fit statistics are used.

My current/future work on this topic

- How replicable is SEM research in psychology?
 - Multi-study pre-registered replication project planned
- Supporting SEM researchers to use pre-registration
 - Pre-registration template for SEM research in development
 - Forked from template for pre-registration in social psych by van' t Veer & Giner-Sorolla (2016)



The screenshot shows a Google Docs interface for a template titled "SEM preregistration template". The document content includes:

Pre-registration template for SEM studies (Williams, 2018) - version 0.1

Project title:

Authors:

Theory/hypotheses

Describe the *substantive* theory and/or hypotheses that you aim to test. This could take the form of a paragraph of text, an enumerated list of enumerated hypotheses, or a diagram. You do not need to specify the full *statistical* model that you will use at this point.

My suggestions:

- Use pre-registration in your own SEM research
 - Suggested venue: <https://osf.io/>
- Comment on/contribute to my pre-registration template for SEM research - <http://tiny.cc/pzhdsy>
- Encourage students to consider pre-registered replications of SEM studies as thesis projects
- If you edit a journal, consider allowing registered reports - i.e., review and conditional acceptance at time of pre-registration. See <https://cos.io/rr/>



References / question time

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<http://hdl.handle.net/10179/16441>

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